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THE

NEW JAIL, TORONTO,

AND

SHEWING THE ADVANTAGES OF HOT WATER OVER
OTHER SYSTEMS, FOR

JAILS, ASYLUMS, HOSPITALS, &c.

BY

GEORGE HARDING, PLUMBER

TORONTO:

PRINTED AT THE LEADER STEAM-PRESS, KING STREET.

1862.



THE STATE OF NEW YORK

IN SENATE

JANUARY 18, 1893

REPORT

OF THE

COMMISSIONERS OF THE LAND OFFICE

IN RESPONSE TO A RESOLUTION

PASSED BY THE SENATE

APRIL 18, 1892

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PREMIUM REPORT

ON

Heating and Ventilating

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TO THE CHAIRMAN
OF THE
BOARD OF JAIL INSPECTORS.

SIR,—

I beg leave to submit the following Report, on Heating and Ventilation, in accordance with your advertisement.

I presume, that in the present day, with the experience we possess, it is needless to use any lengthened argument for the purpose of convincing Society, that the system of warming buildings by heated air, (whatever may be said in its favor as a heating agency), is, in a sanitary point of view, most injurious. It will be readily admitted that the scheme which proposes the passage of volumes of air over surfaces heated, to say, 500 degrees of temperature, thereby depriving them of a great portion of their vital qualities and rendering unpleasantly active the impure gases which consume the oxygen of the atmosphere. No greater argument against its continuance, than a reference to past experience of the system of heating by hot air is required. I will therefore simply state that I utterly condemn it.

Of the correct preference given to steam and hot water heating, over that already mentioned, there can be but little doubt in the minds of disinterested observers, especially when considered from a sanitary point of view; to these I would therefore direct the attention of the Board.

It is admitted by all parties, that, in all arrangements for ventilation, the most perfect in operation and effect, is

that which most nearly approaches a natural ventilation, so that, throughout, the utmost desire should be to avoid, as far as possible, the artificial, and simplify the method.

It is also agreed that the most healthy and genial heat for rooms or buildings, is a steady temperature, of from 65° to 70, fahrenheit, so that, in the outset, I would take this as the most desirable basis. There have, for some time past, been differences of opinion as to whether steam or hot water is the better medium for heating buildings; in the case of the new Jail there is little room to argue the question, for, if there were no greater objection against steam heating, I would consider it almost impracticable in the present instance, without an extravagant expenditure of money.

And I base this conclusion upon facts perhaps not heretofore considered by the parties interested. The most important is the great difficulty in getting a full supply of water for feeding the boilers and generating steam sufficient to heat a building of so great extent; and the next is the great expense attending the same.

Boilers of 150 horse power, which would be required to heat the buildings, and to drive the engine for a fan, which should also be used in connection with steam heating, and to raise its own water for boilers' supply, would require, at the least, 6,500 gallons of water per day, exclusive of baths and other house uses.

Although the Jail is situated near the Don River, whence any quantity of water might be supplied, it must be borne in mind that water cannot be raised to the height of the Jail without the extra cost of an additional engine, and boiler, and force pump, say 10 horse power, which, together with the engine house, laying in of pipes, and connections to the building, will cost, say, at least, \$5,000. Beyond this, there is, also, to be considered, the extra fuel of such engine, &c., say 160 ton of coal, at \$6 to \$9 60, and the

cost of a competent engineer and attendant, say nine months in each year, day and night, at \$3 per day —\$810.

This may be taken as the average yearly cost, exclusive of the engine, &c., which, at the farthest, will not last over ten years, and may, therefore, be added to the other in ten equal parts—making a total of \$2,270 per year for the first portion of the work necessary to *commence* heating by steam.

The only other alternative by which a proper supply of water might be obtained for the purpose, would be by substituting an Hydraulic Ram, and that, if it could be done at all, would be by raising a head of water a distance up the Don River, and running pipes along its banks which would cost quite as much as the other; but supposing the difficulty of obtaining water to be surmounted by the means above proposed, then we must consider the net extra expense of Steam.

To properly heat the Jail, and supply power for the Engine to drive the fan at the building, it will require boilers to the extent of 150 horse power at least. These boilers, pipes and connections, together with engine, fan, &c., will cost \$10,000. There will also be required for their attendance an engineer and fireman day and night, which will cost as before, about \$900 per year.

I have not mentioned the cost of breakage, repairs and other attendance daily required about high pressure boilers and engines; but may safely add, without risk of contradiction from those who have had experience in these matters, that, for both places, \$1,000 per year would be a low estimate.

Taking into further consideration the quantities of coal consumed in these furnaces, beyond what would supply hot water boilers, and which I estimate at 430 tons per year of seven months, there will be a further loss of 260 tons at \$6, and amounting to \$1,560; so that, although the

putting in of the steam pipes and connections alone, cost about the same as hot water pipes, yet, considering the entire contra annual expenditure required on Steam, beyond hot water, it will show a total upon both boilers, engines, &c., of \$5,730.

Again, dividing the original cost of these boilers over ten years, in which time they may be considered as worn out, and adding the other items, we find a total expenditure of \$6,730 per year, over the hot water system; or, viewed in another light, it will cost \$15,000 to build engine houses, purchase engine pumps, boilers, connections, leading pipes from the Don to commence steam heating—all of which, except the pipes, will require to be renewed every 10 or 12 years. Also, \$5,230 per year for extra fuel, incidental expenses, wages, and oil; and all this over and above the cost of hot water system.

It is true, the cost of first engine and boiler building, &c., might be saved if there were any other means of getting water; if wells are suggested, I would only add, that no practical man of sound experience will depend upon well water for boiler supply.

All this may not strike at first thought, and it may appear to some, when, considering the theory of steam and hot water heating, that they are equally good, but, certainly, considering the circumstances and the economy in this instance, the preference must be in favor of hot water, as being the more practicable and less expensive.

I have dealt with the great obstacles of steam, rather than the minor objection which I might here detail, as arguments against it, would space permit, and I wish it to be distinctly understood that I make these statements upon full and long experience, theoretically and practically employed, as I have been, on boilers, machinery, and steam apparatus, and as having diminished rather than increased the figures.

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As the Board desire due regard to economy in the system proposed, and also to carry into use the various constructions already projected for heating and ventilating, I would, upon mature consideration of everything connected with both systems, recommend, without hesitation, the water as more effective in its results, much more economical in its use, attendance and cost, and more suitable for working in with the plan and construction of the Jail building. Accepting this last view, alone, thousands of dollars may be saved. Although I deem it necessary to consider the saving of money, I would, by no means, recommend the hot water system *on this account*, but because I am perfectly satisfied of its more effective use in every other respect.

In adopting the hot water system, their would not be the least use for the outside boiler houses. I would propose to build two small furnaces, one in each wing in the basement, as on the accompanying plan, marked A B C D.

There appears to be no specified use for those compartments, beyond the necessity of arches for the support of the superstructions, so that the furnaces may be very safely, conveniently and cheaply built there; the adjacent spaces to be used, if necessary, for coal holes.

The boilers would require to be four in number, two in each wing, and about 8 feet long and 3 feet in diameter, with six 5 inch flues in each; thus arranged, the whole could be attended to by one handy labourer, day or night, including attendance to the pipes and expansions. From these I propose to convey the flue, as shewn by dotted lines on the plan, into the triangular space shewn on each side of central hall, marked H I and K; if continuing the same to the top of the building, in the form of a common smoke stack, 1 foot 6 inches in diameter, made of boiler iron.

Thus the chamber, being heated without any extra expense, may be converted into a most effectual ventilating shaft for all the corridors and rooms adjoining, and into which may be also inserted, kitchen, baking, day-room or other pipes—each assisting the draft and improving the ventilations. By this arrangement, the cost of the outer boiler houses and chimney stacks would be saved, which, in itself, would be an item of \$2,000 at least. It would also do away with the necessity of a fan and air duct, if steam be adopted, making another saving not before mentioned in the steam expenditure of about \$4,000.

It must be remembered that in order to effect proper heating and ventilation, it is necessary to pay strict attention to the following particulars:

Firstly,—There must be proper means of obtaining a definite supply of pure air, and freely and steadily distributing the same through the various departments. In this the Jail is more perfect than in any other respect connected with this branch of its arrangements, and the change lately made, from small to large windows in its outside walls, although it will require more heating surface, must greatly assist a natural ventilation, aided, also, in a great degree, by its elevated and healthy locality. As has been discovered in the Toronto Lunatic Asylum, so will it be in the Jail, that, during the cold weather, there will be almost a sufficient ventilation. It will be more particularly in summer, that suitable provisions must be made for ventilation. For this purpose, I propose that the architect should carry up through the roof, and finish there as he may please, the two triangular spaces of the kitchen, marked on the plan, H. I. and K. Into those may be entered the furnace flues, stove pipes and other heated pipes which will, without extra expense, create sufficient heat and draught; thus providing an auxillary

means of ventilation at all seasons, by leading foul air-ducts into the same as before described.

Secondly,—The temperature should be regular and properly diffused. There can be no doubt of the superiority of hot water, in this respect, over steam as a heating agent. The temperature in the pipes being always below 212° fahrenheit, and presenting a greater radiating surface than steam, and a more equal heat can always be maintained without the frequent changes that occur in steam, the pipes of which very rapidly, and frequently within an hour, increase or decrease in heat, thereby requiring constant and strict attention. While, on the other hand, every days experience will show that hot water pipes retain their temperature, or five times longer than steam, and, on this account, they may be entrusted to the care of an ordinary servant, without danger.

Thirdly,—The air should retain its fit moisture. If the atmosphere has been deprived of that property so essential to its exhilarating power—there is no artificial means by which it can be restored, and, in a sanitary point of view, this is absolutely necessary, as we discover the necessity of using pans of water on our stoves to give back to the air, by evaporation, the moisture it loses in its contract with the plates of iron; thus, again reducing a positive electricity of the air, and artificially endeavoring to restore its salubrious state. When pipes are rapidly heated by volumes of steam, forced through them, at a temperature of 300° and upwards, as they frequently are, the exsicated state of the atmosphere produced in passing over them, must be detrimental to health, and only some degrees better than that infused by hot air furnaces. But this can never exist upon the hot water system, for the temperature, being always below 212° , cannot be thus deprived of its natural moisture, so essential to health.

Fourthly,—There must be efficient means of discharging the foul air. To this too much attention cannot be given, as the cells in which prisoners will be confined are so small, that, without some sufficient mode of drawing off the vitiated atmosphere, it would be akin to deliberate murder to confine them. Those cells would have been much better ventilated by two openings at the back—one above and the other about 18 inches from the floors. However, this can hardly be effected now. Were it not for the inefficient provisions for ventilating those cells, I would have allowed the towers to stand as ornaments or natural ventilations; but the most effectual mode of maintaining a pure atmosphere, would be by carrying a coil of pipe into each of the towers, so as to produce a strong tractive current, and then, by leading the various flues and air-ducts into those towers, the whole may be well ventilated. Instead of the coil of pipes, a furnace might be used in the towers, but such would entail additional expense of fuel and attendance, which, in one year, would pay the entire cost of pipes that could be heated without extra cost. There seem, at present, to be a provision made for two flues, to conduct the foul air as it is discharged from the cells; such I consider might quite as efficiently be confined to one tube leading into the towers. In the completion of the towers they might be very easily finished with a cap, and trapped so that the current must be always upwards, without the possibility of wind blowing downwards into the shaft. But there is not the least doubt some provisions must be made to heat the towers to ensure a draft, especially in summer, when it is most needed to carry off the fetid atmosphere. The red lines on the basements, and the blue on the ground plans, shew the direction of the heating pipes, by which it will be seen as marked at E F, that I would propose (if the Board thought desirable,) to run several coils of pipes through

the apartments into which the pure air enters, so as to give the same a more genial temperature before passing into the leading duct which supplies the building; and, thus, in a great degree, economize heat above, and give a more lively current to the air—which heat may also be regulated at will. In order, further, to economize the fuel and heat, I have so arranged the pipes and expansions, marked K on the plan, that, in the event of the building not being fully occupied, one boiler may be used in each wing, fuel and heat may be saved and the hot water only distributed in the building, to the centre or dividing walls in each corridor, as will be seen by reference to the blue lines shewn on the plan of the ground floors. The water closets I propose to ventilate after a system introduced by Dr. Joseph Workman, at the Lunatic Asylum, the most effectual ever yet devised, namely: to conduct a tube from each of the soil pipes near the basin to the boiler flue or ventilating stack. By these means, not only is the most perfect draft obtained, and foul air prevented from ascending through the pipes, but the water closet, instead of being a nuisance, becomes a medium for drawing off foul air, engendered in its vicinity.

The strongest objections that any seek to urge against hot water system, is that it is unfitted for this climate, and liable to freeze in the pipes. But against all such objections I would simply refer to the Lunatic Asylum, where it has been used with perfect satisfaction for the last twelve years, and where pipes are exposed in the dome, the highest and least protected part of the building. They are perfectly secure from frost, from the fact before mentioned, of their retaining heat for such a length of time after the fires are down, and a tolerable degree of heat may be obtained by regulating the numbers of pipes. It affords a more genial temperature than any other artificial heat, and allows the application of any degree of heat below 212° .

Besides all other considerations in its favour, the hot water system will entirely obviate any complaints against the supply of water, as the pipes, once filled, keep up a complete circulation, somewhat similiar to the blood through the veins and arteries of the body, and, as there is hardly the least chance for evaporation, they are easily supplied with water, so that 200 gallons per week will suffice for the entire heating apparatus, being only the two hundred and twenty-seventh part required for supplying the steam boilers. Thus it will be seen that an ordinary well or soft water tank, large enough for family use, will supply all the water required, and no danger may be apprehended from its use.

In conclusion, I would state, that if the Board are desirous of obtaining the cost hereof, I have my calculation made, and can supply the same immediately, or any other information required.

All which is respectfully submitted,

GEORGE HARDING.

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